Evaluation of Trenching & Fertilization for Enhancing Douglas-fir Seedling Growth on a Dry Salal-Dominated Site: 1st-year report

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January 1999
(Updated)

- *Fertilization at planting and to a lesser extent disc trenching enhanced Douglas-fir seedling height and stem caliper growth after one growing season although the combination of fertilization and trenching lead to greatest growth.*
- *Fertilizer-induced seedling mortality diminishes when seedlings are planted in trenches.*
- *Seedling mortality may be reduced by placing fertilizer in a neighboring hole rather than in the seedling hole.*

INTRODUCTION

Salal (*Gaultheria shallon*), an evergreen shrub found on low to mid-elevations forest ecosystems on Vancouver Island and the adjacent mainland, has been shown to compete for moisture and nutrients, effectively reducing growth of newly planting seedlings. Past trials documented Douglas-fir seedling growth enhancement with spot scarification and seedling fertilization. Additional trials are required to test treatments established on an operational scale and to evaluate fertilizer treatments (tea bags) which have been developed more recently.

In 1998, a cooperative trial was established on the Malaspina College's Woodlot in North Nanaimo to evaluate trenching and seedling fertilization at planting for enhancing Douglas-fir growth. The two treatments, seedling fertilization at planting using Gromax® teabags (Table 2) and disc trenching creating a salal-free micro-site, were applied separately and together on rectangular plots ranging from 0.06 to 0.1 ha in size. An unfertilized, untrenched plot acts as a control with which to evaluate re-establishment of salal and growth of Douglas-fir in response to treatment.

Table 1. Site Characteristics

BGC Ecosystem	CWHxm1
Site elevation	330m - 375m
Aspect / Slope	E(NE) / 10%
Edatope	2-3 / B-C
Site Index (est.)	22 m
Forest stand	Fd (Pl)

TREATMENTS

The site was logged in the fall and winter of 1997/98 utilizing manual falling and ground-based skidding. A John Deere 748E skidder pulled a TTS Disc trencher (Completed by Wayne Diedrichsen of Silvatil Services Ltd.), creating parallel non-continuous trenches 2.7 meters apart. Maximum trench depth of about 20 cm matched the depth of most salal roots. Planting (Douglas-fir PSB 1+0 415B) and fertilization (1 tea bag in seedling hole) were performed during frequent rainfall in early March, 1998. Seedlings within trenches were planted next to the outside wall.

Table 2. Fertilizer specification (Gromax®)

Formulation	21-6-2 w/Gel (Dry Site)	
Weight / bag	9.0 grams	
Composition	%	Grams
Nitrogen	21.6%	1.9
Phosphoric Acid	6.2%	0.6
Potash	2.0%	0.18

COSTS

Establishment costs on a seedling basis (Table 3) were used to calculate treatment costs for planting 1,500 seedlings per hectare (Figure 1). Lower planting costs in the trenched treatments reflect easier planting conditions compared to untrenched conditions. Costs per hectare range from a low of $750 for the control treatment (no fertilizer or trenching) to a high of $1,100 for the trench plus fertilizer treatment.

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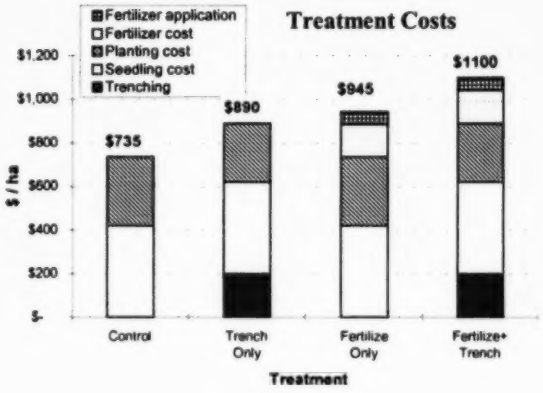
Table 3. Unit costs per seedlings

Activity	$ per seedling
Planting - Trenched	0.18
Planting - Untrenched	0.21
Seedling cost	0.18
Fertilizer - tea bag	0.10
Fertilizer application	0.04
Trenching	$200 per ha.

Figure 1. Total cost per treatment

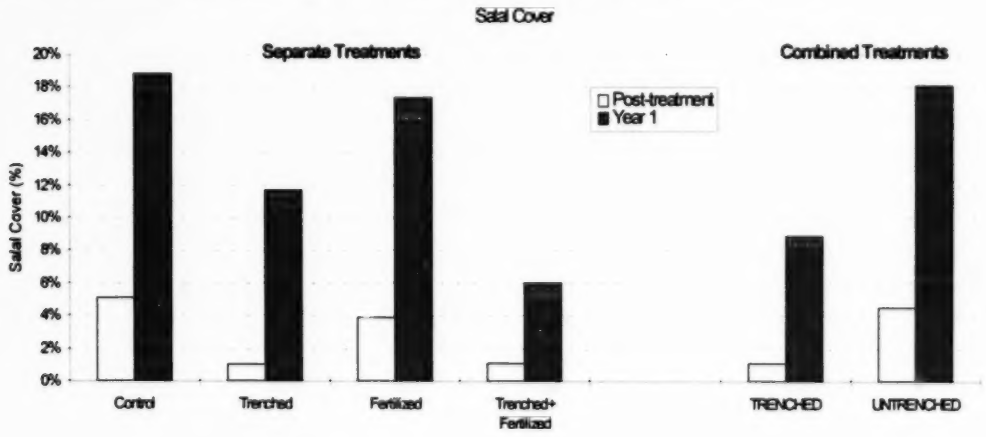


RESULTS

SALAL RESPONSE

Salal foliar cover measurements were summarized by treatment and combined into TRENCHED (trench only + trench with seedling fertilization) and UNTRENCHED treatments (Control + fertilize only) (Figure 2). Salal cover increased in all treatments in the first growing season after harvest although cover in the trenched treatments remain about half of that in the untrenched treatments.

Figure 2. Salal cover, by treatment and by combining trenched and untrenched treatments



DOUGLAS-FIR RESPONSE

First-year assessment of Douglas-fir seedling survival, height and caliper growth revealed differences between the four treatments.

First-year Douglas-fir survival exceeded 95% in all but the fertilizer treatment (Table 4) where foliage on some seedlings appeared brown within weeks of planting and subsequently died. Higher survival of fertilized seedlings planted in trenches may be a result of higher soil moisture due to the lack of an organic layer, allowing dilution of fertilizer in the root zone reducing root burn. An alternative possibility is that trench-planted seedlings growing in salal-free conditions were growing more vigorously and therefore more capable to tolerate fertilizer. High seedling mortality in the fertilizer-only treatment makes it the most expensive treatment based cost per surviving seedling. Douglas-fir's ability to survive amongst untreated salal (control) make the control treatment (plant only) the lowest cost treatment.

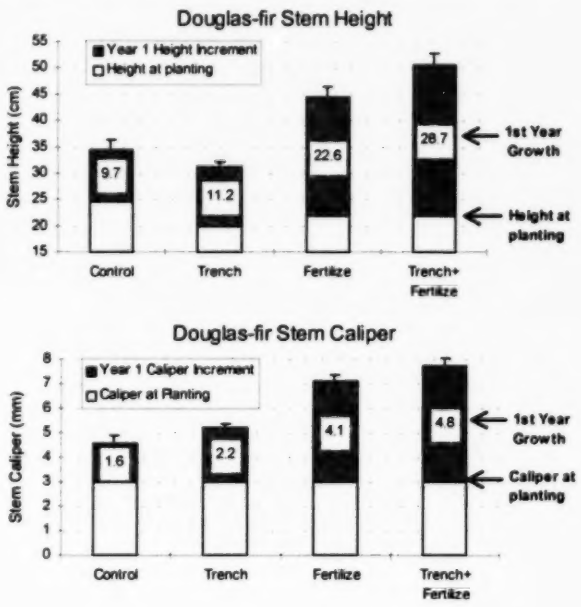
Table 4. First year Douglas-fir survival by treatment

Treatment	Douglas-fir Survival	Cost / Surviving Seedling*
Control	100%	$0.49
Fertilize	79%	$0.80
Trench	98%	$0.61
Trench + Fertilize	95%	$0.77

* based on planting of 1,500 seedlings per ha

Both fertilization at planting and to a lesser extent trenching, enhanced Douglas-fir seedling height and stem caliper growth over untreated control seedlings although the trench + fertilizer treatment lead to greatest growth response, almost tripling first-year height and caliper growth of control seedlings (Figure 3). Douglas-fir growth response was to the trenching and fertilizer treatment was more additive than synergistic. Lammas growth, a second burst of the terminal bud and subsequent stem extension, contributed to height growth enhancement. Over 65% and 53% of sampled seedlings displayed lammas growth in the trench + fertilize and fertilize-only treatment respectively, averaging 13.1 and 9.0 cm in length. Seedlings in the control (13%) and trench treatment (28%) demonstrated lammas growth less frequently averaging 8.2 and 7 cm in length.

Figure 3. Planted Douglas-fir seedling height (cm) and caliper growth (mm) - 1st year results. Figures within bars are 1st year increments. Error bars are 1 S.E. of total height and caliper.



SUMMARY

Enhancing nutrient availability by fertilization has proven a more effective method for increasing Douglas-fir seedling growth than by directly reducing salal abundance either by trenching, as demonstrated in this trial, or by site preparation with herbicides (D'Anjou 1998). Although the combined trenching + fertilization treatment lead to highest growth, the majority of this increase can be attributed to the fertilization. Longer-term trials have revealed growth benefits can be long lasting on these sites effectively reducing time to reach free-growing height requirements by two to three years. Placing fertilizer in a neighbouring hole rather than directly below seedling roots, although perhaps increasing establishment costs, could be justified if seedling mortality is reduced. Site scarification treatments similar to the trenching also can potentially reduce fertilizer-induced mortality although the growth benefits are small after one year. Other potential negative

consequences of fertilization including increased seedling susceptibility to frost damage and browsing have not been observed.

The potential of these treatments to reduce the free-growing period, allowing opportunity to harvest neighboring blocks sooner, may justify higher establishment costs. In the longer term, the potential of increased seedling growth to hasten crown closure, reduce salal abundance and perhaps increase site productivity could provide additional justification for site preparation and seedling fertilization during stand establishment. Additional assessment of the plots will be required to determine longer-term consequences of tested treatments.

ADDITIONAL READING

The following documents provide information on fertilization at planting and enhancement of Douglas-fir growth and establishment on salal sites at lower elevation along the coast. Copies are available from the author. E-mail for additional information.

Brockley, R.P. 1988. The effects of Fertilization on the early growth of planted Seedlings: A Problem Analysis - Min. For. And For. Can., Victoria B.C. FRDA Report No. 011.

Brockley, R.P. 1989. The effects of Fertilization on the early growth of planted Seedlings: A Problem Analysis - Min. For. And For. Can., Victoria B.C. FRDA Research memo No. 081.

D'Anjou, B. N.. 1998. Effect of Herbicide site preparation and fertilization on salal and Douglas-fir growth on Dry sites- 10 year results.- FRBC funded Summary report.

Anon. 1995. Gromax ® and Fertilization at Time of Planing: A Provincial Summary of Operational and Research Experience. Forest Renewal Section. Silviculture practices Branch. B.C. Min. For.

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Acknowledgments

The cooperation of Paul Lucas of Malaspina College and Wayne Diedrichsen of Silvatil Services Ltd. was vital to the establishment of this trial. Review of an earlier draft by Larry Sigurdsen and Phil Comeau is appreciated.